ADVENT

Innovative Fuel Cells & Electrolyzers



Investor Presentation, May 5, 2023

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Advent Technologies Holdings, Inc. - Overview

COMMERCIAL HT-PEM FUEL CELL TECHNOLOGY

- Differentiating **IP** for **High-Temperature Proton Exchange Membrane (HT-PEM) fuel cells**. We manufacture **innovative fuel cell components** and **systems**.
- Our **key markets** are **stationary** (e.g., telecom towers, backup power), **mobile** (automotive, marine) and **portable** (e.g., critical infrastructure backup).
- **Strategic partner** of the **US Department of Energy** for innovative technology development.

ANION EXHANGE MEMBRANE (AEM) ELECTROLYZERS

- **AEM technology** developed by Advent since 2018.
- Milestone of **kW system prototype** expected to be available in **2023**.

GLOBAL MANDATE TO DECARBONIZE

- **US Inflation Reduction Act**: $369 billion allocated towards initiatives related to energy security and climate change, including promotion of clean hydrogen.
- **REPowerEU**: Up to €300 billion allocated to enhance energy independence with focus on green technologies.
- **EU Hydrogen Accelerator**: Goal to produce 10 million tons and import 10 million tons of renewable hydrogen in the EU by 2030.

IPCEI FUNDING

- **EU ratified Advent IPCEI** (Important Project of Common European Interest) **Green HiPo** in **July 2022**.
- Total funding of **€782.1m** ratified for Advent Green HiPo to support **R&D & Production** over an estimated period of 6 years.

HIGH GROWTH PROFILE

- Efficient cash burn path to profitability.
- Significant gross margins at full-scale commercialization.

2021  2022   2023 

Milestones

Advent successfully executes on business plan

Corporate

02/21 Advent listed on NASDAQ, raising $158 million
02/21 UltraCell (U.S.) acquisition
08/21 SerEnergy A/S (Denmark) and fischer eco solutions GmbH (Germany) acquisitions
04/23 New R&D/manufacturing facility opens in Hood Park, Boston

Commercialization

12/21 MoU with BASF to secure supply chain for large scale projects
03/22 Launch of next-gen Ion Pair™ MEA with US DoE
07/22 EU ratifies Advent's Green HiPo IPCEI project (€782.1m)
08/22 Multi-state MoU for a US Northeast Clean H2 Hub

Stationary

10/21 5kW Serene fuel cell systems roll-out in Asian market for Telecom sector
01/22 Supply of Serene fuel cells for Globe Telecom
09/22 3-year agreement with the German State of Brandenburg for Serene fuel cell systems
12/22 Delivery of Serene fuel cell systems to BSZ Netz

Mobility

02/22 Tech assessment with Hyundai Motor Company
03/22 Tech assessment with second global automotive manufacturer
01/23 Marine fuel cell development project with Alfa Laval
02/23 New marine collaboration with Siemens Energy
03/23 JDA with Hyundai Motor Company

Electrolyzers

04/21 Advent's AEM MEA exceeds U.S. DoE targets
05/22 Signing of joint declaration to boost EU electrolyzer production

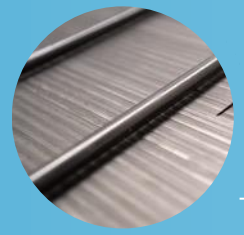
Organization

170+ Employees

38 Successful R&D Programs

700+ Combined Technical Years of Experience

150+ Patents Issued, Licensed, or Pending



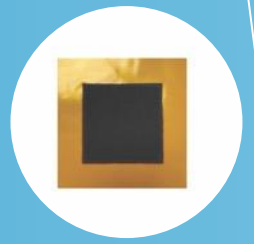
Advent Technologies GmbH
Germany

- Development and assembly of Advent's 5kW-15kW stacks.



Advent Technologies LLC
Silicon Valley, USA

- Portable Fuel Cell Products R&D and Production
- DIGI-TRONIC fuel cell system R&D
- Development of advanced cooling technologies



Advent Technologies Holdings Inc.
Boston, MA USA

- Corporate Headquarters
- Fuel Cell R&D and Manufacturing
- Ion Pair™ MEA production
- Electrolyzer test stations

Advent Technologies A/S
Denmark

- Center of Excellence for fuel cells
- Development and assembly of Advent's 5kW-15kW Serene systems





Advent Technologies SA,
Greece

- Fuel Cells R&D and production
- Electrolyzers R&D and production
- MEA production
- Ion Pair™ MEA product development



Advent Green Energy Philippines Inc.
Philippines

- APAC service center for the telecom market
- Sales, service and site preparation

Our People



Vasilis Gregoriou*
Chairman & CEO



Emory De Castro*
CTO



Kevin Brackman
CFO



Chris Kaskavelis
CMO



Jim Coffey
General Counsel & COO



Naiem Hussain
CIO



Nora Gourdoupi *
SVP, Corporate Business Development



Morten Hougaard Sørensen
SVP, Advent Technologies A/S



Daniel Hennig
SVP, Advent Technologies GmbH



Alan Kneisz
VP, Sales & Marketing



Preben Rasmussen
VP, Advent Technologies A/S



Vasilis Kopelas
VP, Business Development (Green Mobility)



Jochen Baurmeister
CTO's Office



Gregory Guth
VP, Manufacturing



Antigoni Vafeidou
Director of Operations and Legal for Europe



George Paloumbis
Director of Manufacturing



Cynthia Olson
Coating Manager,



Theofanis Spiliotopoulos
HR Manager

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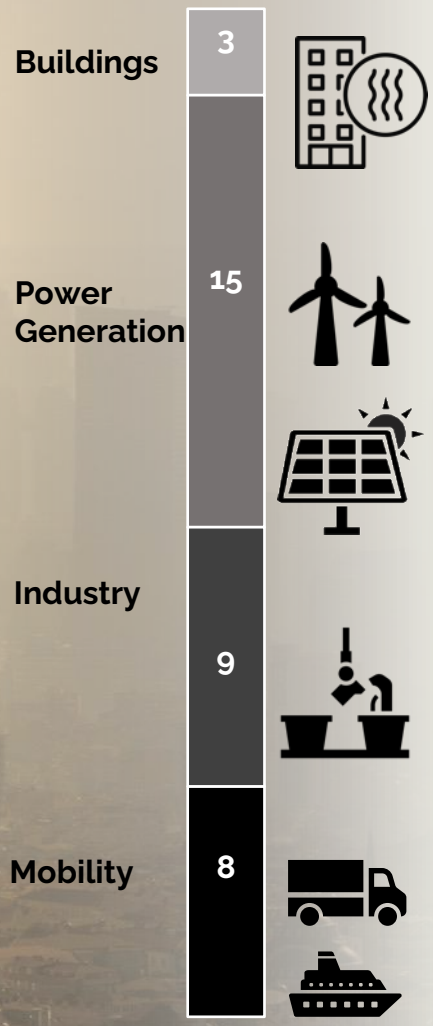
ADVENT

Hydrogen Can Solve 1/3 of Global CO_2 Emissions Problem



Hydrogen

Gt of CO_2 abated

Off-Grid

Immediate **Advent opportunity** to **replace diesel gensets** globally

Long-Term Storage

Hydrogen generation from surplus renewable power is an **ideal solution**

Steel
Fertilizers
Refineries

14% of global CO_2 emissions
200Mt H2->1.5TW electrolyzers needed
(2022: 2GW installed)

Trucks
Marine
Aviation

14% of global CO_2 emissions (excluding passenger EVs)
31,910 TWh 945 MToe of efuel for net zero.

Massive Opportunity for Electrolyzers and Fuel Cells

2030:
100s of GWs of **Electrolyzers**
10s of GWs of **Fuel Cells**



For 1.5°C IPCC Paris Mandate

ADVENT

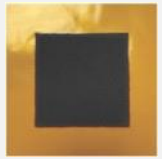
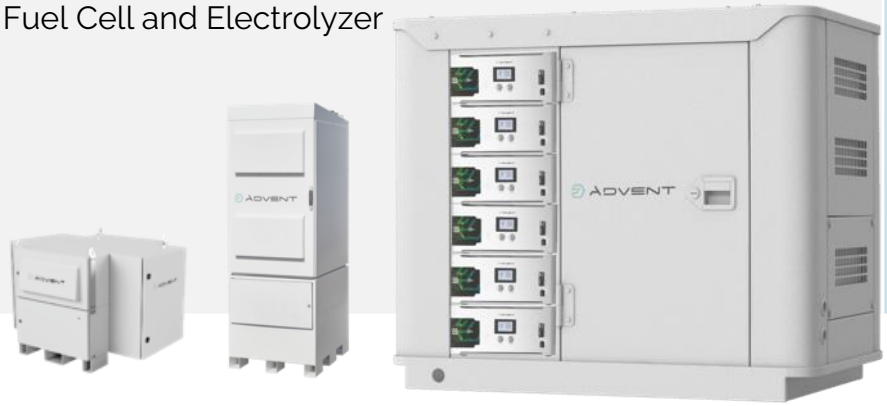


2050:
TWs of **Electrolyzers**
100s of GWs of **Fuel Cells**



For Net Zero Transition

Business Model

	Characteristics	Distribution
MEA (membrane electrode assemblies) HT-PEM and AEM 	• Unique IP • Low capex • High production volume • In-house production	• In-house captive supply for stack manufacture • Direct sales of MEAs to third parties • JDA with Tier 1/OEM for discrete applications (e.g., automotive)
STACK Fuel Cell and Electrolyzer 	• Production levels subject to market demand and Advent approved partner manufacturing capabilities	• In-house captive supply for system manufacture • Standardized core stacks can be supplied to multiple markets
SYSTEM Fuel Cell and Electrolyzer 	• Applicable for stationary, portable, and marine power markets • Unique specification if required by strategic partner • Third party fabrication possible	• Direct sales for stationary, portable and marine power applications • Manufacturing can be licensed subject to use Advent stacks and MEAs

Key Markets

Stationary Power



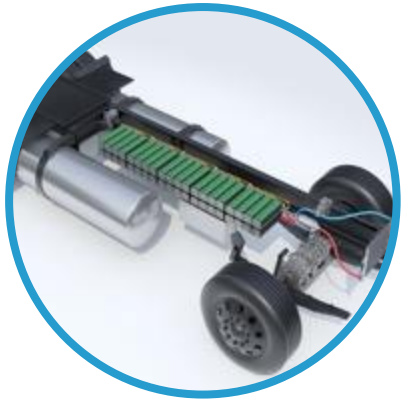
✓ *Diesel Generator replacement*

Marine



✓ *Methanol Fuel Cells to decarbonize Shipping*

Automotive



✓ *Total Cost of Ownership reduction with Advent Fuel Cells*

Electrolyzers



✓ *Green Hydrogen Production*

Stationary Power

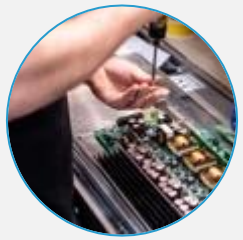
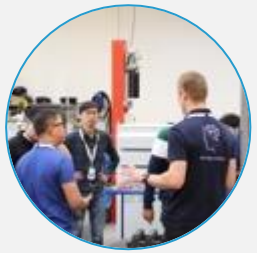
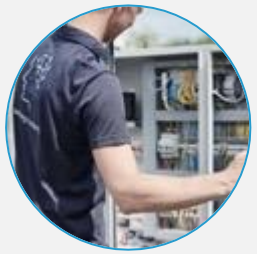
Advent's fuel cell systems replace diesel generators



- 100% reduction in emissions with eMethanol.
- Can operate reliably in **extreme environments**, where backup power is mostly needed.
- Ease of use and deployment allows SereneU to be a **cost effective and efficient way to decarbonize**.

Green | Low-Cost | Proven | Resilient | Configurable

Stationary Power Generation Products

Unit	Systems	Fuel Mix & Accessories	Platforms	Other Services
 **SereneU** The Unit 5kW 4th Gen **SereneU HV** High Voltage Unit	 **SereneS** The System 5kW-15kW  **SereneP & SereneCHP** The Portable System Combined Heat & Power 5kW  **SereneC** The Container 30kW–125kW (*under development*)	 Fuel Mix  Spare Parts & Accessories	 Service Management System  Remote Monitoring	 Advent Academy  Support & Service

Stationary Power: Existing Worldwide Deployments

Telecom Backup Power



Globe Telecom

5G upgrades – Philippines

- 10kW systems on rooftop sites in rural and urban areas
- Proved resilient against natural disasters
- Off-Grid, Bad-Grid
- 24/7 Power

Power Generation



BSZ Netz

Germany

- The Serene 5kW system is one of the portable power stations currently integrated into a mobile solution developed by BSZ Netz

Critical infrastructure Backup Power



State of Brandenburg

Germany

- Backup remotely monitored power for Brandenburg's BOS digital radio network
- Serene fuel cells ensure seamless operation of the entire BOS network in Brandenburg

Marine: Auxiliary & Propulsion

Methanol is reformed on-board to hydrogen, then hydrogen and air enter the fuel cell and are converted to Electricity & Heat





Siemens Energy

Advent and **Siemens Energy** are collaborating to develop a fuel cell solution for the marine industry using Advent's methanol-powered HT-PEM fuel cells. They are also partnering with **Sanlorenzo** to launch the first eMethanol HT-PEM fuel cell project, with the goal of eliminating the need for diesel engines and generators in yachts.

Alfa Laval

Advent and **Alfa Laval** are teaming up with Danish shipowners to explore the use of Advent's methanol-powered HT-PEM fuel cells as a source of marine auxiliary power. The project, funded by the Danish EUDP, will also focus on integrating Advent's Ion Pair™ MEA technology.

Global Shipping Fleets

Advent has formed partnerships with **Neptune Lines** and **Laskaridis Shipping** commencing with pilot programs, where Advent's methanol-powered HT-PEM fuel cells are being tested as auxiliary, backup and emergency power sources.

1. Methanol, Green methanol and eMethanol

Methanol is easy to handle and transport, improving safety. Serene fuel cells using green methanol can reduce CO_2 emissions by over 80% compared to other fuel sources. eMethanol from green hydrogen is expected to power Serene fuel cells, providing net-zero emissions to ships.

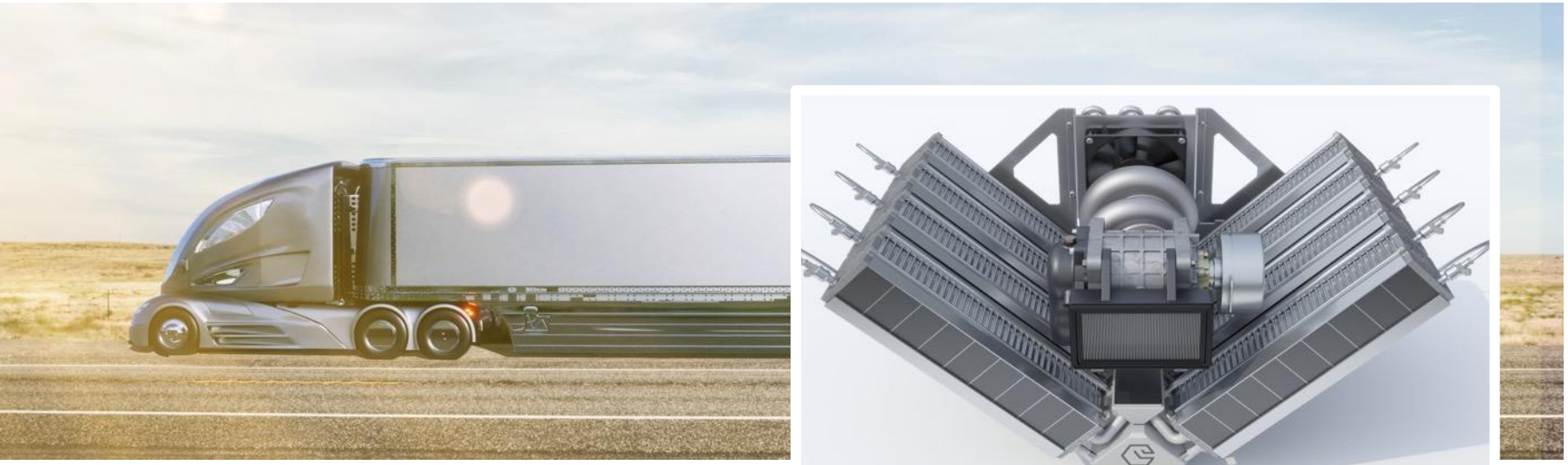
2. Scalable Architecture

Can be configured and stacked to meet electricity needs of up to 250kW.

3. Efficiency

Efficiency target: 45%

Automotive: Heavy-Duty Trucks



Hyundai JDA

Advent and **Hyundai Motor Company** have signed a JDA after a positive tech assessment, aiming to advance HMC-Advent Ion Pair™ MEA, set MEA supply standards, and evaluate Advent's technology for Hyundai's heavy-duty and/or stationary applications.

Tech Assessment
with Global Automotive Manufacturer

Advent and a second global automaker aim to decarbonize the automotive industry with innovative fuel cell technology. Advent's HT-PEM fuel cells and new MEA technology are being evaluated in the first phase, with a Joint Development Agreement anticipated upon successful tech assessment.

Tech Assessment
with Major Fuel Cell Technology Provider for Mobility Applications

Evaluation of Advent's proprietary HT-PEM technology and Ion Pair™ MEA, with a goal of establishing a Joint Development Agreement or licensing Advent's proprietary fuel cell technology.

1. Methanol, H2, eFuels

- Ability to have liquid fuel on board and refill with current infrastructure.

2. Heat Management

- HT-PEM: Unique thermal management characteristics.
- Compact, cost-efficient cooling system.
- Ideal for extreme conditions.

3. Long Range & Fast Recharge

- Maximize Payload.
- Solves the limitations of pure EV trucks.

4. Efficiency

- Use of heat and steam through turbo gen to increase efficiency.
- Designed for high voltage.

Portable Power





Honeybadger 50™

Ultra-compact fuel cell, offering quiet, lightweight power generation on-the-move

- Tested by the US Army.
- Near silent generation of up to 50W of continuous power with clean emissions.
- More than 70% weight reduction compared to batteries.
- Can use windshield washer fluid as fuel.
- Can easily power radio and satellite communications gear, remote fixed and mobile surveillance systems, and laptops.
- **Multiple applications are expected in the future in sectors such as robotics, agriculture, drones, emergency operations, and hospitality (leisure and camping).**

1. Lightweight

Reduces weight vs batteries by 3x to 25x on missions.

2. Resilient

- Continuous operation at -20˚ C to 50˚C.
- Manufactured with materials that are not damaged at extreme temperatures.

3. Fuel flexible

Uses a fuel serviceable filter (like a water filtration kit), allowing it to run on the fuels that can be deployed in defense missions: methanol, JP-8, and even windshield washer fluid.

Advent Principles for Technology Adoption

CHALLENGE

3Es: Environment, Energy Security, Economy

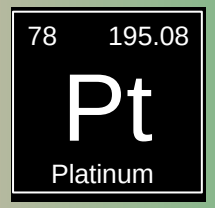
Green solutions must be deployed with TCO in mind; otherwise, they will not gain widespread commercial acceptance. Technology licensing and global manufacturing is needed.

Leverage Existing Infrastructure

Mobility and off-grid power will require H2-based eFuels that leverage existing liquid fuel global infrastructure.

Rare/Expensive Metals Use

Platinum, Iridium, **Titanium**, must be minimized to lead to mass scale-up.



ADVENT PRINCIPLES

Innovate, License & Partner

with Tier1s/OEMs for global adoption. Optimize business model for high-margin, low-capex growth. Retain core IP.



Multifuel Strategy:

HT-PEM FC technology allows for efficient use of eFuels (with off-grid and marine being immediate opportunities for eMethanol).



Materials Innovation:

AEM EC technology for Pt/Ir free electrolyzers.

ADVENT Mission

Innovate & bring to market with strategic partners the HT-PEM fuel cell and AEM electrolyzer technologies.

Advent's Fuel Cell HT-PEM Technology

HYDROGEN

Where infrastructure for refueling & local production is available.

eFuels/METHANOL

eMethanol: Liquid 100% green H2 carrier

Methanol/Biomethanol: Interim, low-cost option for off-grid & marine.





ELECTRICITY

- Stationary, Portable Off-Grid Power
- Heavy-Duty Automotive
- Marine
- Aviation



Advantages

Multifuel
Direct eFuel use (marine, off-grid)
Resilient to low purity H2

Heat Management
Superior cooling = high-efficiency needed for trucks, aviation

Efficiency
Quality heat use can drive efficiency between 50% to 85%

Manufacturing
Simple Design/BoP (no water management) = low-cost to produce

Resilience
Extreme cold/heat, air impurity, humidity conditions



Advent's AEM Electrolyzer Technology

SOLAR

WIND



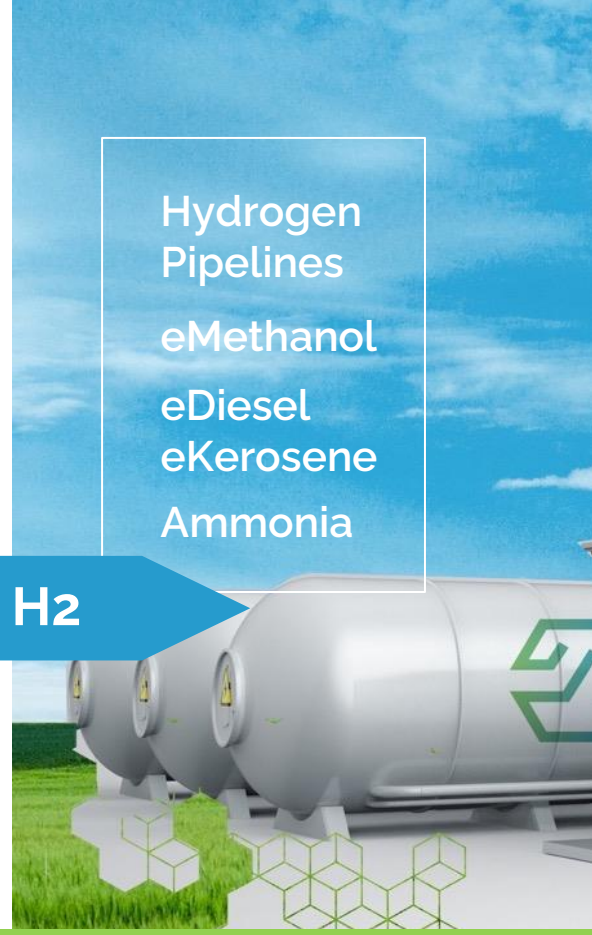
H2

Hydrogen Pipelines

eMethanol

eDiesel
eKerosene

Ammonia



Advantages

No Platinum
Unlike PEM electrolyzers, AEM does not require Pt that costs $100s per kW

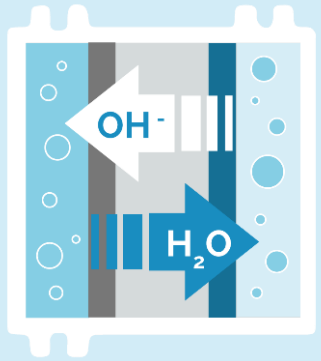
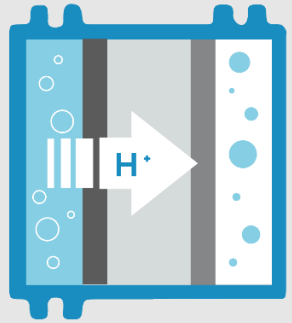
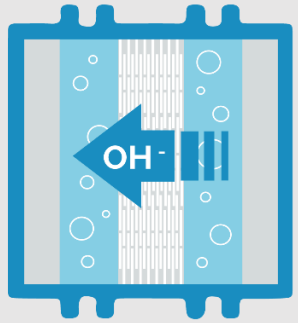
No Iridium
Unlike PEM electrolyzers, AEM does not require Ir that costs $100s per kW

Supply Chain
Established: Rely on abundant non-precious materials

IP
Advent's strong IP in electrodes & membranes & scale-up readiness

Manufacturing
Designed for low cost of manufacturing, long lifetime

Advent Develops AEM Electrolyzers to Lower the Cost of Green Hydrogen Production

Advent	Competition	
AEM	PEM	AWE
		
✓Low OPEX ✓Low CAPEX	✓Average OPEX ✓High CAPEX	✓High OPEX ✓Low CAPEX

Low OPEX:

- Advent's MEA achieves 90% voltage efficiency (key to achieving hydrogen at $1/kg)
- At the MEA level, Advent has exceeded the U.S. DoE target of under 45 kWh/kg H2

Low CAPEX:

- No Platinum, Iridium, or Titanium needed

Financials - Summary

- **Revenue Target** of approximately **$60 Million** in 2026 from Current Business and Product Portfolio.
- Targeting **Cash Flow Positive** in 2026.
- Potential requirement of approximately **$40 Million** of capital in aggregate by 2026 to reach a **Cash Flow positive state**, mainly for working capital purposes and for the production ramp-up.
- IPCEI Funding is **Non-Dilutive Capital** for innovative R&D and First Industrial Deployment of a new R&D and production facility in Greece.
- **Revenue upside** to the business, derived from Green HiPo capacity increase and the launch of state-of-the-art products.

Advent Green HiPo



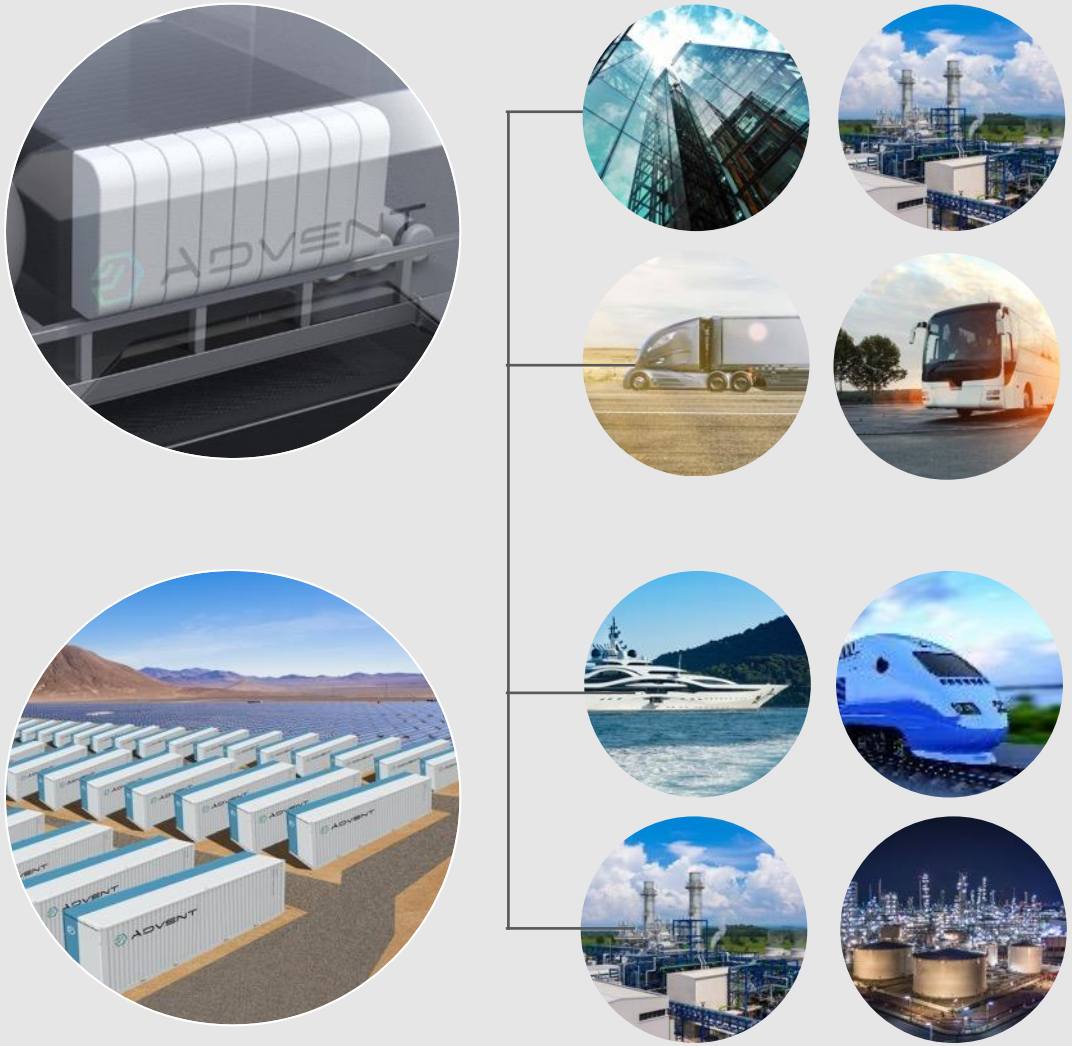
Markets: We are Expanding to Electrolyzers with IPCEI Support

Green HiPo

Innovative Production of HT-PEM Fuel Cells and Electrolyzers in Western Macedonia, Greece

- Advent's Green HiPo is a key IPCEI Hydrogen Technology Project
- IPCEIs aim to achieve economic growth, technological and energy autonomy in the EU
- Total funding of **782.1m €**
- Duration **2022-2027** (with ability to recapture certain expenses back to January 2021)
- Under IPCEI Hy2Tech, Advent was one of only eight SMEs to have received ratification
- **R&D and Production Facilities**
- Direct and indirect cooperation with approximately **20 European entities**
- Electrolyzers: **1.5 GW** over 6 years
- Fuel Cells: **120MW** over 6 years

Green HiPo Off-Takers



Western Macedonia State-of-the-Art Advent Facility

- Approximately 650 new jobs over the next 6 years.
- Beacon of attraction for scientists and specialized professionals from local universities.
- Green HiPo aims to establish Western Macedonia as a strategic hub for the European hydrogen and fuel cell sector.
- Green HiPo will contribute to EU's target of reaching 400GW hydrogen production capacity by 2030.





Our Technology is our Power

- Pragmatic approach to **reduce Total Cost of Ownership** for **Fuel Cells** and **Electrolyzers**.
- **World-class electrochemistry & engineering teams** with **state-of-the-art facilities in Boston**, backed by **government funding** (with planned IPCEI scale-up program).
- Strong traction with Partners for **strategic joint go-to-market initiatives**.
- Focus on **large markets** such as **stationary** and **mobility**.




ADVENT
Thank you.